Center Innovation Fund: JSC CIF

Quiet Fan Technology for Deep Space Missions

Completed Technology Project (2016 - 2018)

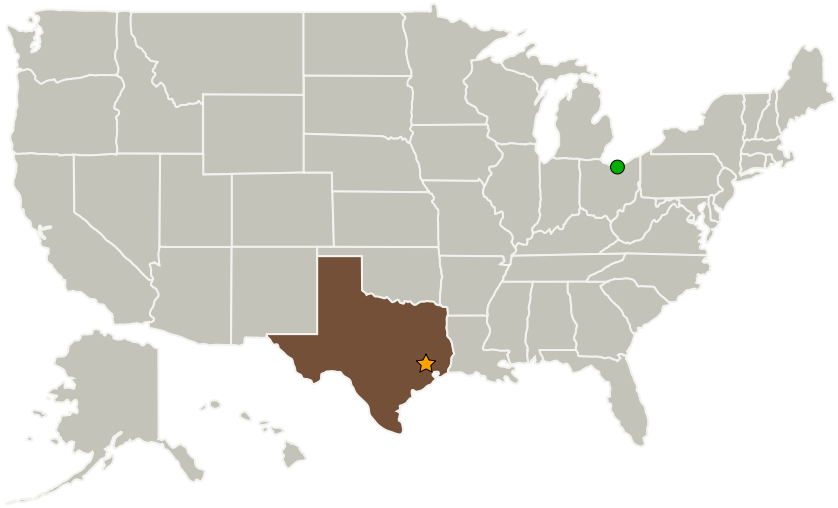
Project Introduction

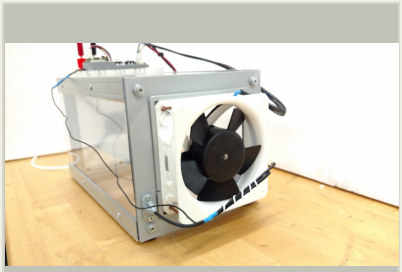
In the first year of this IR&D funded project, NASA working with RotoSub, has adapted a crew quarters (CQ) type fan into a noise canceling quiet fan that uses magnets imbedded in a fan's blades as noise canceling speakers. This fan provides reduced noise emissions of the first two major fan tones by 15-20 dB, providing an overall reduction of 6-7 dB, with minimal airflow loss. ISS has plans in the near term to replace the existing fans in each of the 4 CQs. Investing a second year of funding into this project will go toward the flight certification of this hardware, allowing for an in-space demonstration of this technology, which would help open the door for the integration of this technology into the Deep Space Gateway and Transport (DSG&T) and future exploration missions. This technology has the potential to reduce noise of other types of axial fans, making this technology feasible for use in payloads and other flight hardware applications.

Anticipated Benefits

The long term benefits of this technology for spaceflight are significant. This technology effectively reduces noise while maintaining and even slightly improving fan performance. Integrating this technology into space vehicles will result in considerable mass and volume savings, which is extremely valuable in any space vehicle and especially so in a deep space vehicle or habitat like Orion and Lunar Orbital Platform - Gateway.

Primary U.S. Work Locations and Key Partners





Dual Modulation Loop ANC Quiet Fan in Demo Plenum

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Organizations Performing Work	Role	Type	Location
Johnson Space Center(JSC)	Lead Organization	NASA Center	Houston, Texas
Glenn Research Center(GRC)	Supporting Organization	NASA Center	Cleveland, Ohio
RotoSub AB	Supporting Organization	Industry	Linkoping, Outside the United States, Sweden

Co-Funding Partners	Type	Location
RotoSub AB	Industry	Linkoping, Outside the United States, Sweden

Primary U.S. Work Locations
Texas

Project Transitions

October 2016: Project Start

September 2018: Closed out

Closeout Summary: Some of the accomplishments this year included optimizat ion of the fan blade profile and hub attachment, improved modulation control th rough blade design optimization, development of a new and more robust fan ho using constructed from aluminum, the integration of fan ANC electronics into the central hub of the fan, and mounting the ANC microphone from the frame of the fan to make for a fan package with all ANC components fully integrated into a si ngle piece of hardware. The conclusion of our year 2 work gives us hardware at a TRL 7.

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Johnson Space Center (JSC)

Responsible Program:

Center Innovation Fund: JSC CIF

Project Management

Program Director:

Michael R Lapointe

Program Manager:

Carlos H Westhelle

Principal Investigator:

Christopher O Allen

Co-Investigator:

Andrew J Boone

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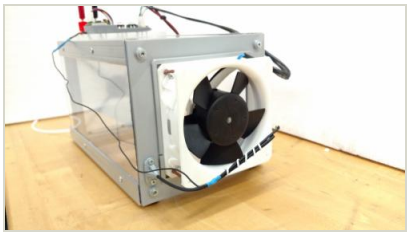
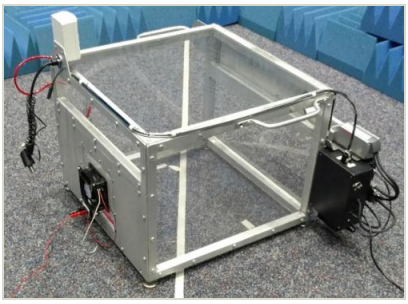
Images



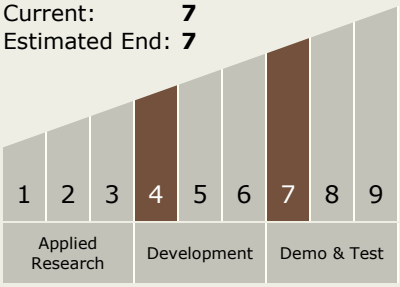
Dual Mod Loop Fan in Demo Plenum
Dual Modulation Loop ANC Quiet Fan in Demo Plenum
(https://techport.nasa.gov/image/28139)



Fan Sound Power Test Plenum
ISO 10302 Fan Sound Power Test Plenum (on loan from NASA Glenn Research Center). This hardware (half-sized plenum) allows for aerodynamic loading of fans while allowing sound radiating from the fan to pass through the walls of the box.
(https://techport.nasa.gov/image/27909)

Technology Maturity (TRL)

Start: **4**
Current: **7**
Estimated End: **7**



Technology Areas

Primary:

- TX15 Flight Vehicle Systems
  - TX15.1 Aerosciences
    - TX15.1.4 Aeroacoustics

Target Destinations

The Moon, Mars, Earth

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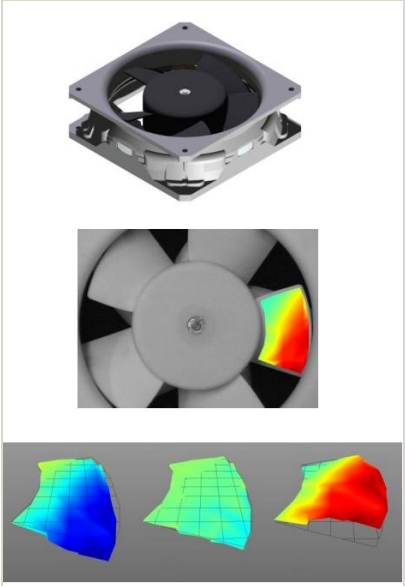
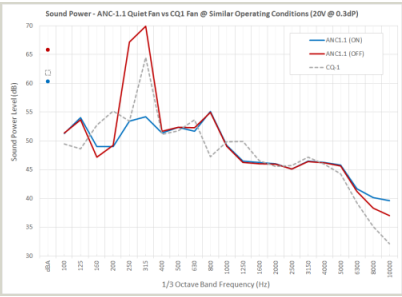


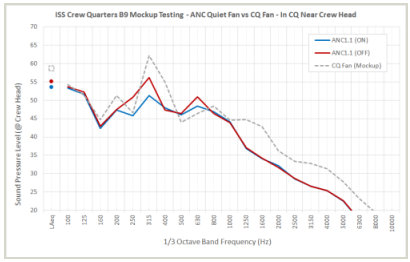
Noise Control using Fan Blade Movements

This technology uses magnets imbedded in a fan's blades as noise canceling speakers to globally reduce noise as the fan operates nominally.
(https://techport.nasa.gov/image/27910)



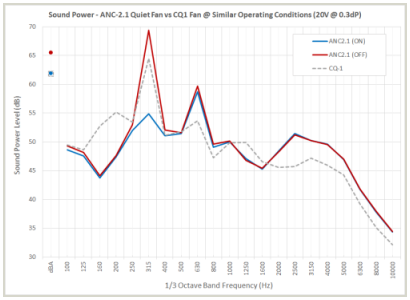
Sound power of Single Mod Fan

Sound Power of Single Modulation Loop Fan with and without ANC Control. This fan is showing about 15 dB of reduction at the BPF.
(https://techport.nasa.gov/image/28140)



Quiet Fan Sound Measurement in CQ Mockup

Sound Level Performance of ANC Quiet Fan in Crew Quarters Mockup. The primary BPF shows a reduction of 10+ dB from the original CQ fan.
(https://techport.nasa.gov/image/28142)



Sound Power of Dual Mod Fan

Sound Power of Dual Modulation Loop Fan with and without ANC Control. This fan is showing a 10-15 dB reduction of the BPF, but no reduction in the second harmonic and an increase in the higher frequency broadband compared to the CQ fan.
(https://techport.nasa.gov/image/28141)

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Project Website:

https://www.nasa.gov/directorates/spacetech/innovation_fund/index.html#.VQb6gUjJzyE